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ABSTRACT

This paper discusses a computer-based prototype called TestMaker that enables educators to create computer-based tests. Given the functional needs of faculty, the host of research implications computer technology has for assessment, and current educational perspectives such as constructivism and their impact on testing, the purposes for developing TestMaker were: (1) to create a test development module that provides instruction on test creation to meet an expressed need of faculty; (2) to create a computer-based test development tool that facilitates easy test creation; (3) to create an experimental tool that helps examine computer-based testing processes; and (4) to develop a computer-based module that incorporates testing strategies aimed at facilitating higher-order learning. TestMaker was designed in HyperCard, and consists of three main components--a test creation module, an advisement module, and a test module. The three modules are examined in detail. Strategies for creating interaction during testing are also reviewed. Two figures illustrate screen displays for the advisement and test creation modules. (Contains eight references.) (MAS)

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TestMaker: A Computer-Based Test Development Tool

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Introduction

From the beginning of the 1900s paper-and-pencil testing has been the standard means of administering achievement tests and many other educational measurements to learners (Olsen, Maynes, Slawson, & Ho, 1989). The proliferation of computer technology in society within the last forty years and the decreasing cost of microcomputers have enabled computers to be utilized for a variety of educational purposes. Some of the more standard uses have been in the area of assessment (Eaves & Smith, 1986).

Computers serve numerous functions related to assessment. Advancements in technologies enhance the computer's potential for improving test administration, scoring and reporting (Olsen, Maynes, Slawson, & Ho, 1989). Computers are capable of managing many of the clerical duties embedded in the assessment process. Moreover, they broaden our expectations and provide worthwhile insights into what should be measured and the methods most conducive for measurement (Johnson & Harlow, 1989). They provide educators with a more accurate experimental tool with which to manage the delivery of instruction, as well as learner assessment. Computers are not only capable of presenting test items but evaluating them as well.

Several factors may be attributed to the assimilation of computers into educational assessment, some of which are presented below. With conventional paper-and-pencil tests there is a considerable time lapse between the time of testing and the time at which test results are reported. These shortcomings prevent them from having much use in assisting teachers and learners in everyday educational pursuits. Consequently, educators and instructional designers have directed their efforts to finding new techniques and tools in order to curtail the current limitations associated with many assessment methods. Their attention, in many cases, has been focused on computer technology and, as Johnson and Harlow (1989) point out, computers are the likely tools for enriching the theory and practice of educational assessment.

A second factor influencing trends toward using computers in educational assessment is the administrative advantage this technology offers. Eaves and Smith (1986), for example, support computer use for learner assessment because of increased efficiency in test duplication, administration,

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scoring, item banking, record keeping and analysis. The major benefit computers provide relative to printed test administration are evident in two primary areas: test administration and test evaluation. Some enhancements related to test administration are standardized test administration conditions, individually administered tests, immediate test scoring, increased variety of testing formats, and ability to collect test and item latency information (Olsen, Maynes, Slawson, and Ho, 1989). Johnson and Harlow (1989) point out that the primary advantages that computers offer evaluation are effective and efficient scoring, objectivity -- computers have the advantage of being totally objective which is not possible with a human, and more organized assessment.

Assessment is a fundamental part of education. Traditionally, multiple-choice, true/false and object type tests have been the predominant means of assessment. While used heavily and appropriate in many cases, current educational perspectives (e.g., constructivism) require that assessment also focuses on higher order thinking and problem-solving abilities. Operations and strategies which are incorporated in courseware must account for and facilitate deeper levels of cognitive processing (Jonassen, 1988). A potential advantage of computerized testing is the capability to allow users to interact with testing. Research suggests that allowing for interaction during testing promotes learning. For example, giving learners the opportunity to respond to feedback was found to facilitated higher levels of achievement. Activities during computerized testing which help learners relate new information to existing knowledge (e.g., responding to feedback) may prove beneficial to learning and should be considered by instructional designers. It is possible that as computerized testing procedures become more interactive and dynamic, higher order learning may be facilitated.

The research literature appears to support the claim that computer and paper-and-pencil test administration produce comparable results in learner achievement scores. Studies investigating this question generally indicate computer testing to be closely equivalent to paper-and-pencil tests in terms of achievement scores. Stile and Pettibone (1983), for example, found no significant differences in acquired scores when comparing computer testing to paper-and-pencil. Eaves and Smith (1986) report that undergraduate college students' achievement scores on computer administered tests are similar to that of paper-and-pencil. Olsen, Maynes, Slawson, and Ho (1989) show that the scores obtained from paper-administered tests, computer-administered tests, and computer-adaptive tests are equivalent.

The paper will discuss a computer-base prototype called TestMaker that enables educators to create computer-based tests. The prototype is being designed to incorporate student record keeping and scoring, techniques for interactive testing, and advisement on test creation. Strategies for creating interaction during testing are also reviewed.

TestMaker Objectives

Despite the fact that many programs that have been created for computer-based test construction, educators frequently rely on paper and pencil. Several reasons may account for this such as the unavailability of technology, unfamiliarity with technology and/or the inability to tailor test creation programs to meets individual needs. The development of TestMaker was initiated by several requests from faculty at Eastern Illinois University for a computer-based test development tool that , among other things, would: 1) provide instruction on effective strategies for creating tests and; 2) assist in the

creation of computerized tests that evaluate and record student performance. The program is designed as an instructional and developmental tool for teacher-education students.

Given the functional needs of faculty, the host of research implications computer technology has for assessment, and current educational perspectives such as the constructivism and their impact on testing; the purposes for developing TestMaker were:

1) to create a test development module that provides instruction on test creation to meet an expressed need of faculty ;

2) to create a computer-based test development tool that facilitates easy test creation to meet an expressed need of faculty,

3) to create an experimental tool that helps examine computer-based testing processes and;

4) to develop a computer-based module that incorporates testing strategies aimed at facilitating higher order learning.

Overview of Prototype Design

TestMaker is presently a prototype that consists of three main components: a test creation module, an advisement module and a test module. The test creation module enables developers to select a test type (e.g., multiple-choice). Once a test type is selected the developer can enter questions, feedback, and subsequently create a student test file. With the current prototype, multiple-choice tests can be created. It will eventually include true/false, matching and open-ended response test types. Running concurrently with the test creation module is advisement . At any point during test creation developers have the option to execute the advisement module to obtain information about such topics as writing effective questions and types of feedback. The third component is the actual test. From the test creation module a student test file is created. This module is fully executable and thus a student sitting at a computer can take the test, interact with it and receive feedback on their performance.

The prototype was designed in HyperCard. The designers pilot tested the instrument to determine the type of design features potential users needed and wanted. After some initials trial tests it became apparent that the test development module would require greater flexible than could be provided with HyperCard. While HyperCard proved useful for getting a model up and running, the designers decided that when full development is implemented a programming language (e.g., C) will be used.

Modules of TestMaker

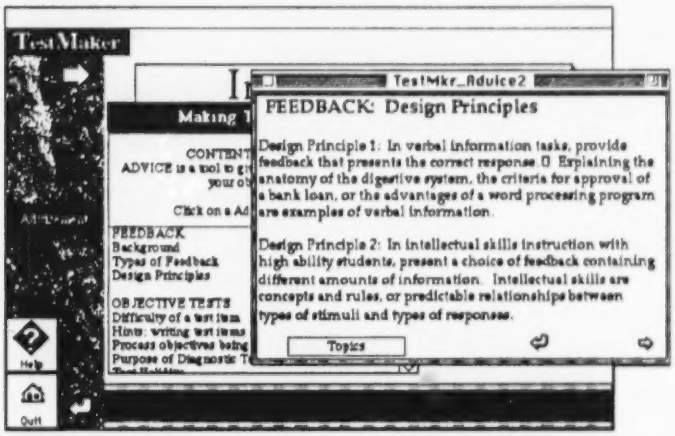
Advisement Module

Teacher-education students are the primary audience for which this program was designed. Many of these students have limited knowledge of effective test creation. Thus, the designer needed to create a facility in which developers could obtain advice on how to effectively create multiple-choice, true false, matching and open-ended questions. Two types of advisement are provided: user selected advice and system generated advice. TestMaker includes an advisement module which runs concurrently with the test creation program so that users can select key words to access advice on particular topics. For

example, developers can get advice on types of feedback, hints for writing test items, test items length and complexity (see Figure 1). This advisement is referred to as user-selected advice. When developing a test, the prototype will automatically provide advice on effective testing strategies (e.g., suggesting an appropriate number of alternatives for multiple choice questions if the user attempts to enter too many). This advisement is referred to as system generated advice.

Figure 1

Screen Example: Advisement Module with TestMaker


TestMaker
TestMkr_Advice2
FEEDBACK: Design Principles
Design Principle 1: In verbal information tasks, provide feedback that presents the correct response. Explaining the anatomy of the digestive system, the criteria for approval of a bank loan, or the advantages of a word processing program are examples of verbal information.
Design Principle 2: In intellectual skills instruction with high ability students, present a choice of feedback containing different amounts of information. Intellectual skills are concepts and rules, or predictable relationships between types of stimuli and types of responses.
Topics
FEEDBACK
Background
Types of Feedback
Design Principles
OBJECTIVE TESTS
Help
Quit

Test Creation Module

This prototype is being designed as a test development tool and an instructional module. To create a multiple choice test, for example, the user enters each question, a correct answer and alternatives simply by typing in predefined text blocks (see Figure 2). Previously created questions can be viewed and edited. Prompts guide users through the test creation process (e.g., "Enter the number of alternatives." or "Identify the correct answer.") and when necessary the system generates advice. For instance, if a user attempts to create 15 alternatives for a particular test item, the system indicates that too many alternatives are requested and it recommends an appropriate number to use for that test item. User-selected advice is available at any time during test item creation.

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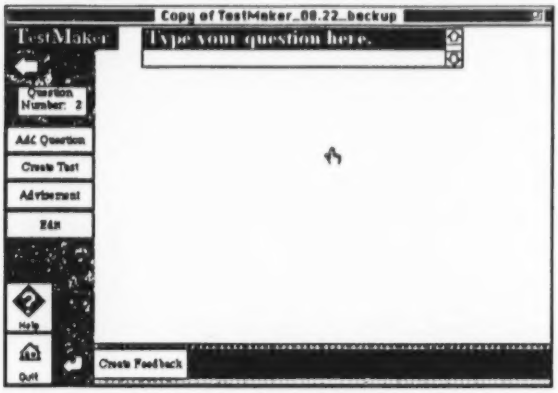
Figure 2

Screen Example: Creation Module



For each question, developers can incorporate feedback which will be displayed for students during testing. As a form of feedback, the correct answer can be presented for incorrect responses. Thus, if the instructor enters feedback and selects the correct answer display option, then; upon responding incorrectly to a test item, the student would be presented the correct answer along with the instructor's feedback.

Also available during development is an option for interaction during testing. While still being refined, this feature allows test takers to respond to feedback, explain their answers and to defend why they are right or wrong. For example, if the instructor had selected this option, then; upon responding to a particular test item, students would be prompted to elaborate as to why their response was correct. The student would then type an explanation which could later be reviewed by the instructor. Requesting students to elaborate on their responses is intended to facilitate the integration of new information or not yet learned content with their existing knowledge. Elaboration includes meaningful additions or constructions which help to improve an individual's recollection of learned content (Levin, 1988). Elaboration is hypothesized to facilitate information recall by generating alternate information retrieval channels and by providing additional information for the formulation of responses (Gagné, 1985). Marrone (1990) found that allowing students to respond to feedback in computerized testing facilitated higher levels of achievement. In this respect, the testing experience becomes itself a type of learning strategy which helps to facilitate learning.

Testing Module

From the test creation module the actual test file is created. This file can be given to students on disk or over a local area networks. Students, taking the test are presented questions to which they respond. All question items, correct answers, alternatives and feedback created in the test creation module are

presented. Students are given a grade upon completion. During testing, student responses, elaborations and instructional time are recorded to a file which can later be reviewed by the instructor.

Summary

Computer-based testing has existed for several years. It appears to offer many advantages to educators including effective and efficient grade reporting and immediate feedback to students. A primary function of the testing program discussed in this paper is to help individuals learn how to construct effective tests and to provide them a means by which to do so. Thus, by creating an easy-to-use test development tool, which incorporates system-generated and user-selected advisement, it is hoped that the intended audience will be better able to create effective assessment instruments. Moreover, when considering assessment, in light of constructivist approaches, it is necessary to view measurement of learning in terms of higher order processing and problems solving. This module, while intended to meet faculty needs for objective tests (e.g., multiple-choice), includes features that will potentially help students generate their own meaning from information and subsequently construct knowledge. Features such as interactive testing and allowing learners to pose arguments as to why responses are right or wrong may be facilitative of higher order learning and are deserving of further research.

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